

Physics 112

Study Notes for Exam I

Chapter 17 Wave Optics

1. Wave Model

Wave Equation: $v = f\lambda$

Index of Refraction: definition and implication for wavelength in material

2. Interference

Coherence

Double slit interference

Conditions for constructive and destructive interference

Be able to judge when you are justified in using small angle approximations

3. Diffraction Grating

Condition for constructive interference

Be able to judge when you are justified in using small angle approximations

How does intensity pattern depend on number and spacing of slits?

4. Interference by Thin Films

Condition(s) for change of phase at reflection

Conditions for constructive and destructive interference of waves reflected from two surfaces. Remember to compensate for wavelength change when $n > 1$.

5. Diffraction and Interference from Single Slits and Circular Apertures

Huygens' Principle

Conditions for destructive interference in 1-slit diffraction

Width of central max in 1-slit diffraction

Angular extent of central maximum in circular aperture diffraction

Chapter 18 Ray Optics

1. Ray Model

Light Sources

Point

Extended

Reflective

2. Reflection

'Law' of Specular Reflection

Diffuse Reflection

Objects and Images in Plane Mirrors

3. Refraction

Snell's Law

Total Internal Reflection

4. Color and Dispersion

Know what dispersion is and how n changes with λ

You may skip the section on colors and filters

5. Image Formation by Refraction

Main focus of this section is apparent depth beneath flat surfaces

6. Thin Lens Ray Tracing

Real & Virtual Images

You may be asked to *sketch* a ray diagram for a situation, but you will not be required to make a detailed *scale* ray diagram on the exam.

Understand Example 18.8. You should be able to do that kind of analysis for any single lens, converging or diverging for any object distance.

7. Image Formation by Spherical Mirrors

Real & Virtual Images

You may be asked to *sketch* a ray diagram for a situation, but you will not be required to make a detailed *scale* ray diagram on the exam.

Understand Example 18.11. You should be able to do that kind of analysis for any single mirror, converging or diverging for any object distance.

(Incidentally, you can treat objects and images for plane mirrors with this technique... just give a flat mirror an infinite focal length and see what the equations tell you.)

Chapter 19 Optical Instruments

1. Finding Images of Lenses and Mirrors

Lens Equation 19.3

Magnification 19.4

Sign conventions for s , s' , f (lecture notes)

Combinations of Lenses

2. Camera

Typical camera lens forms real inverted image of 'distant' object on film or CCD plane. Lens equation is satisfied when image is in focus.

You may skip Controlling the Amount of Light

3. Human Eye

Focusing and Accommodation

Disorders: Near- and Far-sightedness

Near- and Far- Points

Correcting disorders: Examples 19.7 & 19.8

4. Magnifier

Angular Magnification

Equation 19.8 is also used to define the 'Magnification' of eyepieces of Microscopes, (*e.g.* can obtain f from information like '10x lens').

5. Microscope

Angular Magnification Eq. 19.10

Note individual objective and eyepiece magnifications: $M_o = \frac{-L}{f_o}$ and

$M_e = \frac{25cm}{f_e}$. Objective and eyepiece lenses are often labeled with a number

followed by an x. These relationships are understood in that notation.

Be familiar with Fig. 19.21. Note that the parameter L is not really the length of the tube (but your authors call it that). L is actually the image distance of the objective lens. (I would call the length of the tube $L + f_e =$ distance between lenses, but they didn't ask me.) Use authors' definitions and pictures to make easy use of Eq. 19.10.

6. Telescope

Angular Magnification Eq. 19.11

Telescope people never use terms M_o and M_e , just focal lengths.

For object at ∞ , objective makes real image of size $h' = -f_o\theta_o$, where θ_o **must be used in radians**. (This is how you find the size of an image on a film when the telescope's objective is used as a camera lens.)

7. Resolution of Optical Instruments

You may skip this section.

Chapter 20 Electric Forces and Fields

1. Charges and Forces

No equations in this section, but lots of conceptual material.

Know it all. Know it well.

2. Charges, Atoms and Molecules

Charge Conservation

Conductors and Insulators

Don't worry about Hydrogen Bonding

We will study dipoles in considerable detail later.

3. Coulomb's Law

Electric force between two charges.

This is force that *each* particle exerts on the other (Newton's Third Law has not yet been repealed.) Note equal length force arrows in Fig. 20.16.

Superposition of Electric Forces: Examples 20.1 and 20.2

4. Electric Field

Definition Eq. 20.3

Field lines of positive and negative point charges Fig. 20.26

q is *source* of field. Field exerts force $\vec{F} = q'\vec{E}$ on 'test' charge q' .

Force is along \mathbf{E} when q' is positive, opposite \mathbf{E} when q' is negative.

Field of charge q exists whether or not q' is present to feel it.

Electric fields obey superposition just like electric forces.

5. Applications

Uniform field between flat parallel plates carrying equal and opposite charges is

$$E = \frac{Q}{\epsilon_0 A} = \frac{\sigma}{\epsilon_0}, \text{ where } \sigma \equiv \text{charge per unit area.}$$

6. Conductors

Conductor in electrostatic equilibrium has zero field inside. It may be polarized in the presence of external charges. Any *net* charge on a conductor must reside on the surface (think about why this must be so).

7. Forces and Torques on Charges

Net force on test charge q' is $\mathbf{F} = q'\mathbf{E}$. Torque on dipole $\mathbf{p} \equiv q\mathbf{d}$ in \mathbf{E} is

$\tau = pE \sin \theta_{pE}$, where θ_{pE} is the angle between \mathbf{p} and \mathbf{E} , and the direction of $\boldsymbol{\tau}$ is such that \mathbf{p} wants to align with \mathbf{E} .